1269021

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DRAWINGS ATTACHED

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(54) SIGNATURE COLLATING APPARATUS

(71) We, J. W. CLEMENT COMPANY, a Corporation of the State of New York, United States of America, of TC Industrial Park, Depew, State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to an improvement in a signature or sheet collating apparatus of the type disclosed in our application 59061/68 Serial No 1221450.

In the apparatus disclosed by this prior application each feeder delivering to a collating conveyor is provided with a calipering device to detect malfunction of the feeder, and the several calipering devices are connected to a monitoring device, which is adapted to interrupt operation of the system only if there is indicated more than a predetermined number of successive malfunctions at any one feeder station. Otherwise, the continuous high speed operation of the apparatus is not interrupted and the monitoring device instead effects a delayed action rejection of an imperfect book at a station beyond the last feeder of the apparatus.

A disadvantage of the prior apparatus is that feeders downstream of the feeder at which a malfunction occurs, continue to operate normally, such that the rejected book contains all signatures except the one from the malfunctioning feeder. Since all rejected books must be hand sorted and the respective signatures returned to appropriate feeders, considerable expenditure of a worker's time is required to correct each malfunction in the apparatus.

The main object of the present invention is to improve the apparatus disclosed by the above mentioned patent application, in order to reduce by up to 50% the amount of worker's time required to sort signatures of rejected books.

According to the invention there is provided a signature collating apparatus comprising a collating conveyor, a series of means for delivering individual signatures to the collating conveyor so as to progressively build at spaced stations along the conveyor books of signatures each of which books is completed at the last means of the series and for detecting a signature delivering malfunction at any one of said series of means which would produce an imperfect book, drive means for operating said collating conveyor and said series of means in continuous high speed fashion, rejection means for rejecting an imperfect book at a station beyond said last means of said series, and means responsive to detection of a malfunction any one of said means of said series indicating the initiation of an imperfect book for sequtially disabling successive means of the series, whereby no signatures are delivered by said successive means of the series to such imperfect book.

Preferably said series of means includes a series of feeders and a series of malfunction detecting caliper means associated one with each said feeders, and said responsive means includes monitoring means actuated by said caliper means for actuating said rejection means and feeder disabling means, said feeder disabling means being actuated by said monitoring means in response to detection of a malfunction by any one of said caliper means indiciating the initiation of an imperfect book at a given feeder for sequentially disabling succeeding feeders of the series.

In an apparatus as set forth in the two preceding paragraphs, feeders downstream of the feeders at which a malfunction occurs are temporarily disabled sequentially as the imperfect books pass thereby such that the rejected book will contain only those signatures dispensed onto the collating conveyor prior to the occurrence of the malfunction. Since a malfunction of the first feeder may produce a rejected book with no signatures, whereby a malfunction of the last feeder will produce a book in which only one signature may be missing, it will be apparent that the average rejected book contains half of the possible number of signatures and thus on the average requires half as much of a worker's time to sort the signatures thereof.

[Price 25p]

The present invention will now be more fully described with reference to the accompanying drawings wherein:

Fig. 1 is a semi-schematic, side elevational view of a collating apparatus embodying the present invention;

Fig. 2 is a fragmentary, large scale sectional view taken through one of the signature feeders, as generally indicated by line 2—2 of Figure 1;

Fig. 3 is a perspective view illustrating a calipering device employed with signature feeder;

Fig. 4 is a view similar to Fig. 3 but showing the arrangement of parts when a feeding malfunction occurs;

Fig. 5 is a perspective view illustrating a vacuum head pic-up device employed with each feeder;

Fig. 6 is a fragmentary view showing the pickup head in operation;

Fig. 7 is a view similar to Fig. 6, but showing the pick-up head rendered inoperative;

Fig. 8 is a diagrammatic view illustrating the circuit employed for selectively disabling the pick-up head and caliper associated with each feeder;

Fig. 9 is a diagrammatic view of the monitoring device and related components; and

Fig. 10 is a block diagram illustrating the prinicipal components of the monitoring device.

Fig. 1 illustrates a signature collating apparatus of the type comprising essentially a series of aligned feeders 10 adapted to deliver signatures 12 from associated magazines 14 onto a collating conveyor 16, which is arranged to travel from left to right, as viewed in Fig. 1, in order to deliver books of assembled signatures at the right hand end of the conveyor to a book binding facility or the like, not shown. The number of feeders empoyed in any given machine will depend upon the number of different signatures that are to be collated into book form.

Feeders 10 and conveyor 16 may be of any preferred type and form no part of the present invention, but are of course driven from a common power source, not shown, so as to synchronize the delivery of signatures to the conveyor as it advances the signature collation sequentially from one feeder to another. However, to facilitate description of the present invention feeders 10 are shown as being of the type adapted to dispense only one signature during each full rotational cycle thereof and for this purpose as being provided with a single signature clamping device 18, operable to alternatively clamp and release such signature. Furthermore, each feeder includes in combination a vacuum head pickup device 20, which when pivoted in the manner indicated in Fig. 5, is adapted to pick up the bottom-most signature from magazine 14 and thereafter transfer same into association with feeder clamping device 18.

Pick-up device 20 is shown generally for purposes of reference in Figs. 5—7 as including a pick-up head 22, which is mounted for movement with a tubular support 24 into which is connected a flexible conduit 266 arranged in communication with a suitable source of vacuum, not shown. Tubular support 24 is suitable supported on the frame work of the collating machine for rotation in opposite directions under the control of a linkage 28 such that head 22 is moved, once during each rotational cycle of the feeder, along an accurate path for the purpose of picking up and transferring a signature, as mentioned above.

Also, as is conventional, there is provided in association with each of feeders 10 a calipering device 30, which is adpated to sense the occurrence of a malfunction in the operation of its associated feeder. A malfunction may be in the form of the failure of pickup device 20 to timely deliver a signature, the delivery of more than an intended number of signatures or the delivery of signatures which are rendered faulty because of being torn or otherwise multilated.

Calipering device 30 is shown particularly in Figs. 3 and 4 as being of the type including a signature feeler or sensing arm 32 and a feeler arm position sensing linkage 34. Feeler arm 32 is pivoted on eccentrically located pin 36 and normally biased into a first or normal position, wherein it is disposed in engagement with the peripheral surface of feeder 10, as indicated in full line in Fig. 4, by tension spring 38. It will be understood that when feeder 10 is rotated to position a signature 12 of a proper thickness in contact with feeler arm 32, the latter is forced to pivot against the bias of spring 38 into an intermediate position shown in Fig. 3, and that the feeler arm is forced into a second position, shown in phantom line in Fig. 4, when the signature is of greater than a pre-determined or proper thickness, or plural superposed signatures are carried by the feeder. Suitable means, not shown, is provided to adjust feeler arm 32 in accordance with the pre-determined thickness of the signature to be sensed.

Linkage 34 includes a first arm 40 having on one end thereof a pair of spaced stops 42a, 42b. Stops 42a, 42b are adapted to engage the upper end of feeler arm 32 when the latter is in either of its first and second positons, indicated in full and phantom line, respectively, in Fig. 4; or alternatively adaped to receive feeler arm 32 therebetween, when the latter is in its intermediate position, shown in Fig. 3. Arm 40 is pivotally supported intermediate its ends, at 44, on one end of a second arm 46, which is in turn supported intermediate its ends on a stationary pivot shaft 48. A ma-

chine framework attached tension spring 50 tends to rotate first arm 40 in a clockwise direction about pin 44, as viewed in figs. 3 and 4, such that first arm actuating end 52 is normally disposed in abutting engagement with second arm stop abutment 54 for all positions of the second arm.

It will be understood by referring to Figs. 3 and 4, that a machine driven timer cam element 56 is employed to pivot second arm 46 about pivot shaft 48 between its normal position, indicated in phantom line, and its actuated position, shown in full line, during that portion of each rotational cycle of feeder 10 at which a signature is to be brought thereby into engagement with feeler arm 32. In this respect, it will be apparent that when no signature is fed at the proper time or too many signatures are fed, so as to position feeler arm 32 in either of its positions shown in Fig. 4, stops 42a, 42b will engage the feeler arm and thereby force first arm 40 to pivot about pin 44, so as to bring actuating end 52 into engagement with a feeder detector microswitch 60. However when a signature of proper thickness is being fed, feeler arm 32 is disposed in the position indicated in Fig. 3, such that stops 42a, 42b receive the upper end of the feeler arm therebetween and as a result do not serve to pivot first arm 40 in the manner described above into contact with detector switch 60.

It will be understood that detector switch 60 is arranged to send an electrical impulse to a monitoring device, generally designated as 62, whenever the feeder with which it is associated malfunctions in any respect.

Referring to Fig. 9, it will be seen that monitoring device 62 is driven by a signal produced by a transducer 64. The transducer 64 may be of any desired form which may be driven in synchronization with the drive means for the apparatus but is shown for purposes of illustration as including a rotatably supported cam disc 66 having a magnetic element 68 adapted to sweep past a pickup 70 once every revolution of the feeders 10. The shift input pulse produced by this transudcer is timed to shift the monitoring device subsequent to operation, if any, of the switches 60 of the individual calipers 30.

To appreciate better the operation and function of the monitoring device, reference may be had to our above-mentioned earlier application. However, for purposes of the present description, specific reference is made to Fig. 10, wherein the monitoring device 62 is shown as including a series of functional elements 72 corresponding in number to the number of feeders involved in the feeder series performing the building of the completed signature books. Further, there is provided a functional element 74 corresponding to an ejector or reject station, which is positioned beyond the last feeder in the series, and one or more intermediate functional elements 76 corresponding to stations between the last feeder in the series and the reject station, the purpose of which will be presently apparent.

The functional elements 72, 74 and 76 are shifting elements connected seriallly to form a shift register, each of which is connected as shown to the shift input signal. Each of the shifting elements 72 is provided with an input from an associated one of the detector switches 60, so that the information "bit" produced by closure of any one of the switches will be inserted into its corresponding shifting element 72. It will be understood of course that a detector switch 60 is closed only in response to a malfunction associated with that particular feeder. Subsequent to actuation, if any, of any one of detector switches 60, continued rotation of the last feeder drum will cause a shift input signal to be applied simultaneously to all of the shifting elements 72, 74 and 76 (see also Fig. 1). By the time this further rotation of the feeders is effected, a completed book will have reached the station beyond the last feeder of the series at which is located the ejector or reject mechanism 78 and of course all of the other books being built will have been correspondingly advanced.

When the shift input is applied to the shifting elements, the malfunction indicating "bit" is advanced forwardly in the shift register, so that when the imperfect book stemming from any malfunction reaches the reject station, the reject mechanism is actuated to reject the imperfect book by means of a solenoid 80 connected through a suitable amplifier 82 to the output 84 of the shift register.

The monitoring device is capable of rejecting individual books without causing stoppage of the collating apparatus, while permitting the stopping of the collating apparatus if there is an indication of gross malfunction at any one feeder. This latter function is achieved in the specific example shown in Fig. 10 by providing a second means in the monitoring device (the first means being the shift register) which is capable of detecting the presence of a train of successive malfunction signals from any one of the switches 60, which train consists of a number of pre-determined successive pulses from the same switch 60 in excess of some pre-determined maximum. For example, in the specific example shown in Fig. 10, any switch 60 which indicates two successive malfunction signals will cause the collating apparatus to be stopped.

This second means, as shown, comprises a plurality of AND gates 88 associated one with each of the shifting elements 72. One input to each AND gate, indicated by the reference character 90, is connected directly to the associated feeder detector switch 60, while the other input, indicated by reference character 92, is connected to the transfer leg of the next succeeding shifting element 72. In the case of the AND gate 88 corresponding to the last

feeder of the series, the second input 92 is connected to the transfer leg of the next succeeding intermediate shifting element 76. It will be appreciated that if both of the inputs 90 and 92 indicate a malfunction signal, this corresponds to two successive malfunction signals from the same switch 60. In this situation the output 94 of the particular AND gate 88 involved will pass to OR gate 96, which in turn produces an output 98 for actuating a relay 100 serving to interrupt the drive to the collating apparatus.

It has been found that from a practical standpoint, a train of two pulses from the same switch 60 usually means that a gross malfunction has occurred incidental to that particular feeder. However, if desired, means other than AND gate 88 may be employed to accumulate more than two malfunctions signals before effecting stoppage of the apparatus.

It will be appreciated that the presence of the intermediate shifting element 76 is necessary to perform the logic for stopping operation of the apparatus due to gross malfunction at any feeder. Also, it will be understood that ejector 78, in the particular instance shown in Fig. 10, will be required to be displaced from the last feeder of the series by a distance corresponding to two feeder stations. It will also be appreciated that the feeder stations are equidistantly spaced since the reject mechanism operates on a linear base.

Thus, if at any time any one of the caliper devices 30 sends, due to operation of switch 60, an impulse to the monitoring system 62, the shift register will "follow" the signature collation, which has thus been identified as defective, throughout the extent of the collating apparatus; and that upon its arrival at the reject station it will be kicked out of the delivery line; all without any slowdown or interruption of the collating and delivery processes.

The above described monitoring device is improved in accordance with the present invention by providing an arrangement for temporarily disabling feeders downstream of a feeder at which a malfunction is detected sequentially, as a book rendered imperfect by such malfunction, passes thereby. The feeder disabling arrangement is best shown at Fig. 8 as including a solenoid 110, which serves to control valve 112, which in turn is adapted to control passage of pressurized fluid, from a suitable source, not shown, through tubular support 24 to pick-up head 22. When solenoid 110 is energized, valve 112 is operated so as to permit passage of high pressure fluid to pick-up head 22, such that the vacuum condition normally prevailing therein is changed to a positive pressure condition. This serves to prevent the picking up of a signature by the pick-up head and thus effects disabling of the feeder with which such pick-up head is associated.

Referring to Fig. 10, it will be seen that the input to solenoid 110 associated with a given feeder, indicated by reference character 114, is connected into the transfer leg from the last preceeding shifting element 72. Thus, when the shift input is applied to the shifting elements, the malfunction indicating "bit" is advanced forwardly through the shift register, so that the feeders downstream of the point at which the malfunction occurs are each in turn disabled as a book rendered imperfect by the malfunction passes thereby. By this arrangement, an imperfect book when rejected, will contain only those signatures dispensed onto the collating conveyor prior to the occurrence of a malfunction, whereby the time necessary to hand sort the signatures of a rejected book will be substantially reduced.

The present improved apparatus further includes an arrangement for temporarily disabling calipering devices associated with feeders downstream of a malfunctioning feeder, so as to prevent the intended disabling of such feeders from producing a malfunction signal operative to effect stoppage of the system. The calipering device disabling arrangement is best shown in Figs. 3—4 and 8, as including a solenoid 116, which is operable to extend a plunger 118 into abutting engagement with feeler arm 32. The position of plunger 118 when solenoid 116 is not energized is shown in Fig. 4. In this position, feeler arm 32 is adapted to freely pivot about pin 36 between the full and phantom line positions shown in Fig. 4 for the purpose of indicating feeder malfunction. When solenoid 116 is energized, plunger 118 is moved into its extended position, shown in Figs. 3 and 8, wherein it serves to maintain feeler arm 32 in its intermediate position against the action of return spring 38, thereby permitting feeler arm 32 to be received between stops 42a, 42b when linkage 34 is operated in the manner described above.

The input to solenoid 116 associated with a given feeder indicated by reference character 120, is connected into input line 114, such that both of solenoids 110 and 116 of each feeder downstream of a feeder at which a malfunction occurs are simultaneously operated. As in the case of the feeder disabling arrangement previously described, there is no need to provide a calipering device disabling arrangement in combination with the first feeder of the series.

It will be appreciated that the solenoid operated disabling circuit is shown only in its most simplified form for use with a feeder adapted to dispense only one signature during each rotational cycle thereof. For feeders adapted to dispense two or more signatures during each cycle rotation, it would of course be necessary to energize these respective solenoids during differing portions of the rotational cycle, so as not to interfere with the feeding or detecting of the presence of signatures to be fed to properly formed books. It will also be understood

that the term "signature" as used herein is intended to mean a single non-folded sheet as well as folded or plural sheets.

WHAT WE CLAIM IS:—

1. A signature collating apparatus comprising a collating conveyor, a series of means for delivering individual signatures to the collating conveyor so as to progressively build at spaced stations along the conveyor books of signatures each of which books is completed at the last means of the series and for detecting a signature delivering malfunction at any one of said series of means which would produce an imperfect book, drive means for operating said collating conveyor and said series of means in continuous high speed fashion, rejection means for rejecting an imperfect book at a station beyond said last means of said series, and means responsive to detection of a malfunction at any one of said means of said series indicating the initiation of an imperfect book for sequentially disabling successive means of the series, whereby no signatures are delivered by said successive means of the series to such imperfect book.

2. Apparatus according to claim 1, wherein said series of means includes a series of feeders and a series of malfunction detecting caliper means associated one with each of said feeders, and said responsive means includes monitoring means actuated by said caliper means for actuating said rejection means and feeder disabling means, said feeder disabling means being actuated by said monitoring means in response to detection of a malfunction by any one of said caliper means indicating the initiation of an imperfect book at a given feeder for sequentially disabling succeeding feeders of the series.

3. Apparatus according to claim 2, wherein said monitoring means includes a shift register having shifting elements corresponding one with each of said feeders, said shifting elements being serially interconnected, each of said shifting elements being connected to one of said caliper means associated with a corresponding feeder such that a malfunction indicating signal may be inserted thereinto, each shifting element having a malfunction indicating signal transfer leg connected to the next succeeding shifting element, and means for producing a shift register input to said shift elements for each signature delivery operation of said feeders, and said feeder disabling means for each succeeding feeder of the series includes mechanism connected into the transfer leg from the last preceeding shifting element.

4. Apparatus according to claim 3, wherein said series of means additionally includes a series of signature supply magazines associated one with each of said feeders, each said feeder is of the type having associated therewith a vacuum head pickup device movable to transfer signatures from an associate signature magazine thereonto for delivering to said conveyor and means connecting said head to a source of vacuum, and said mechanism includes solenoid operative valve means and a source of pressurized fluid, said valve means when operated serving to connect said source of pressurized fluid to said head in order to disable same.

5. Apparatus according to any one of claims 2 to 4, wherein said monitoring means includes secondary monitoring means for interrupting said drive means in response to a predetermined number of successive malfunctions detected by any one of said caliper means, said responsive means additionally includes caliper disabling means actuated by said monitoring means in response to detection of a malfunction by any one of said caliper means indicating the initiation of an imperfect book at a given feeder for subsequentially disabling successive caliper means of the series, whereby non-delivery of signatures by said succeeding feeders is not detected by said caliper means associated therewith.

6. Apparatus according to any one of claims 2 to 5, wherein said caliper means is of the type including feeler means disposable in a first position when in surface contact with said feeder and being movable into a second position upon engagement thereof with a signature being delivered by said feeder having greater than a predetermined thickness, said feeler means being disposable intermediate said positions upon engagement thereof with a signature of said predetermined thickness, and means to detect the position of said feeler means such that a malfunction is detected when said feeler means is in either of said first or second positions during delivery of said signature by said feeder, and said caliper disabling means includes a solenoid means, said solenoid means being connected into said transfer leg from the last preceding shifting element and when actuated serving to move said feeler means into said intermediate position.

7. Collating apparatus substantially as herein described with reference to the accompanying drawings.

MARKS & CLERK,
Chartered Patent Agents,
Agents for the Applicants.

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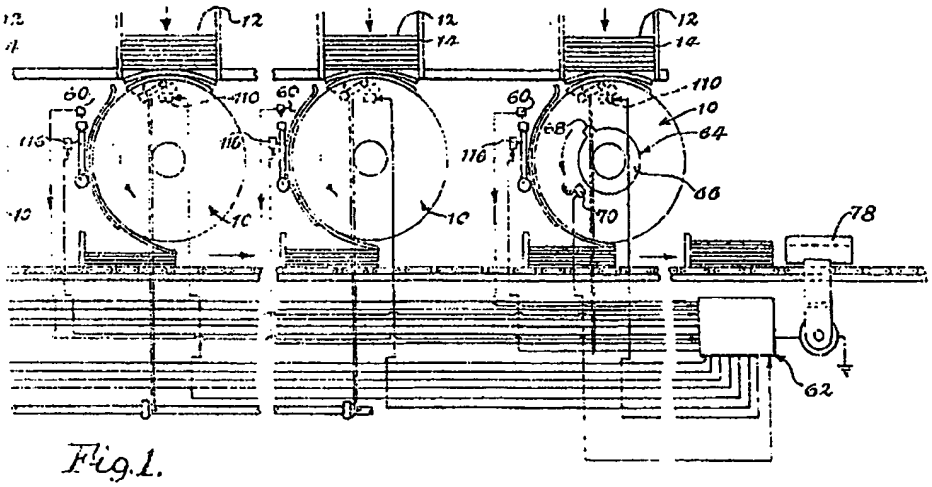

Fig.1.

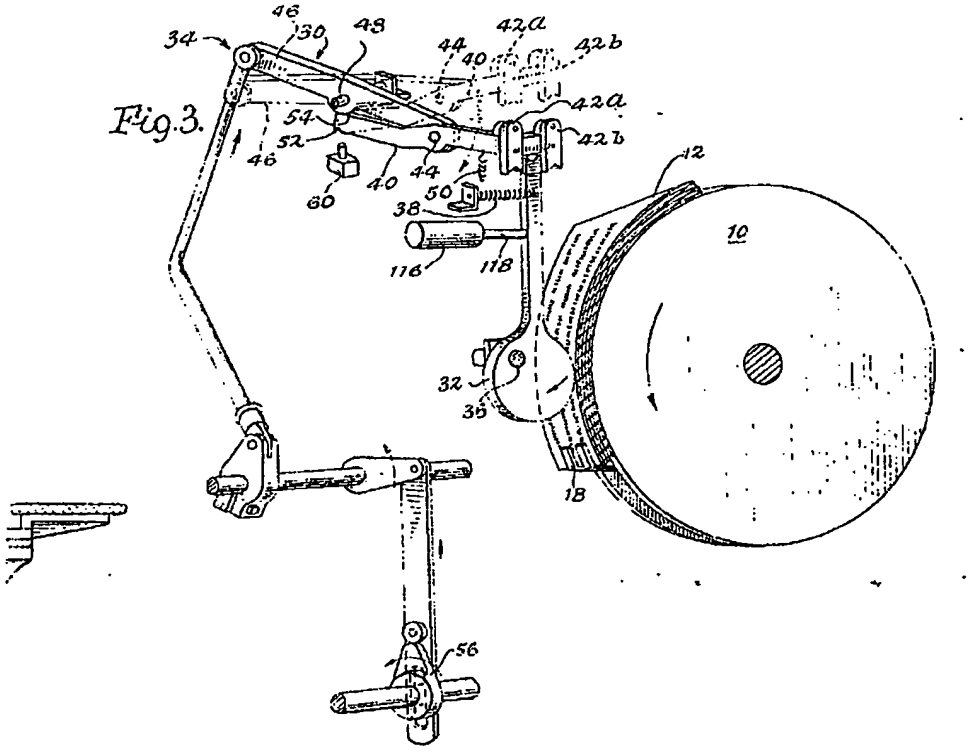

Fig.3.

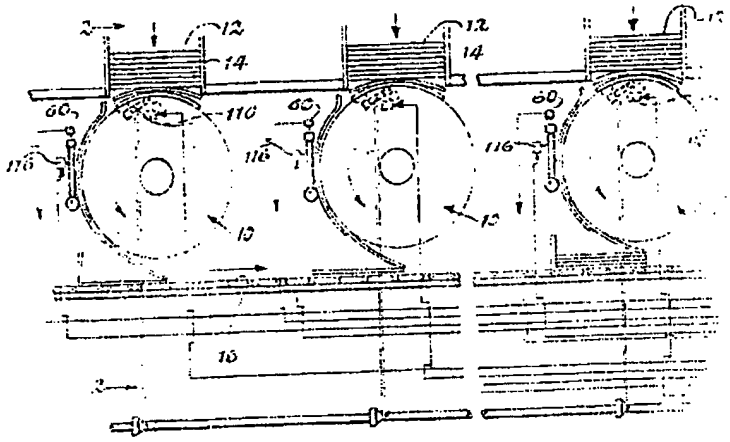

Fig.1.

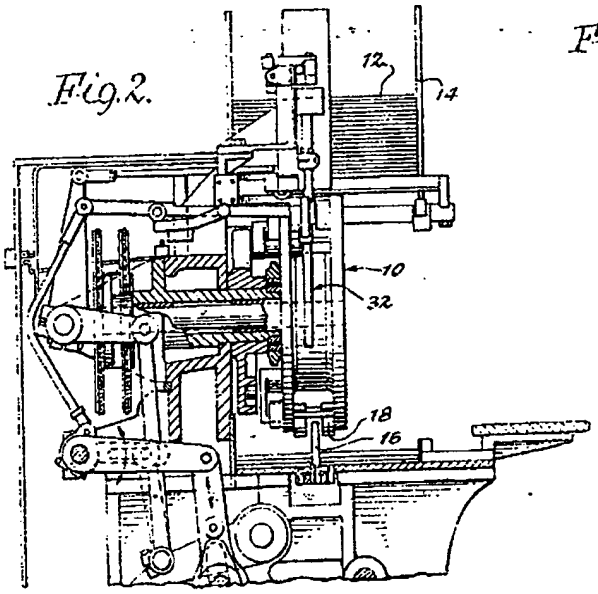

Fig.2.

Fig.3.

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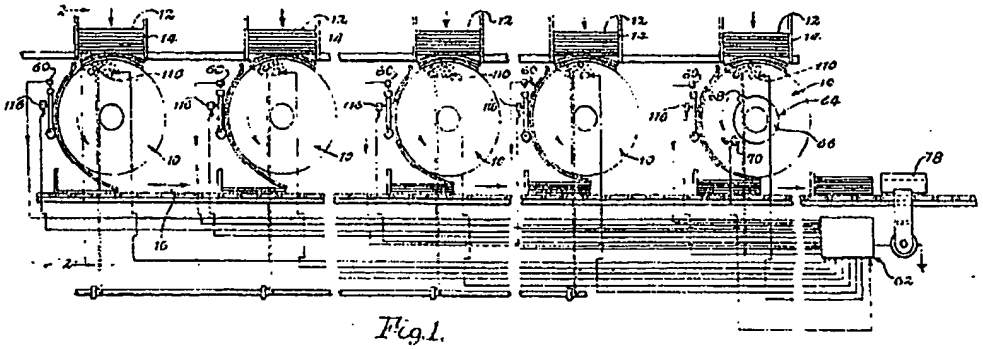


Fig.1.

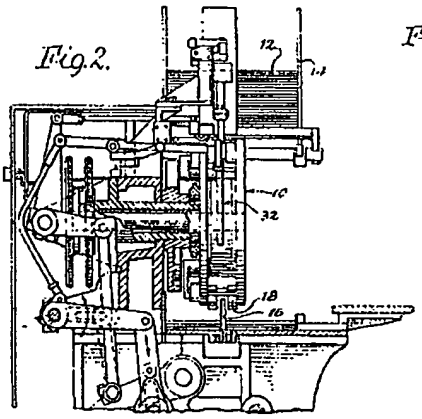


Fig.2.

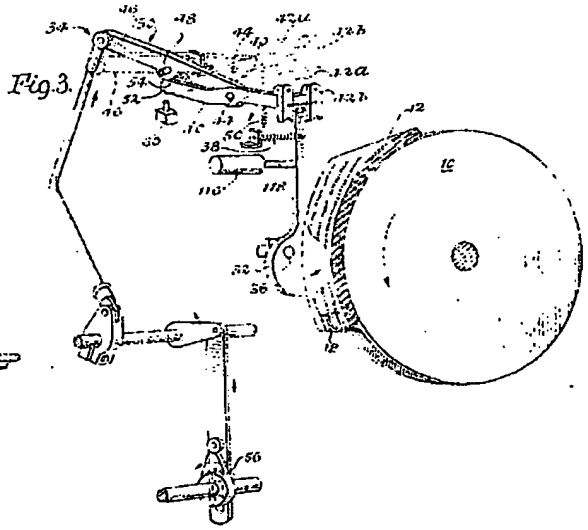


Fig.3.

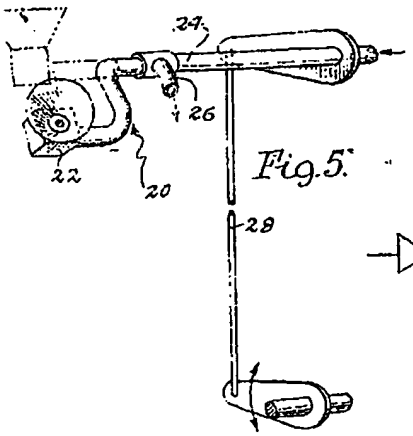


Fig.5.

Fig.8.

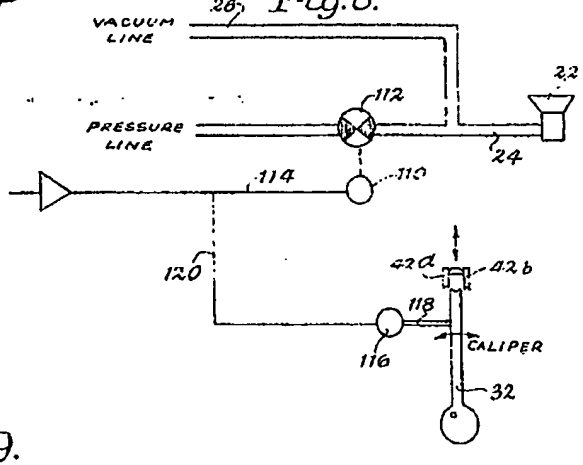
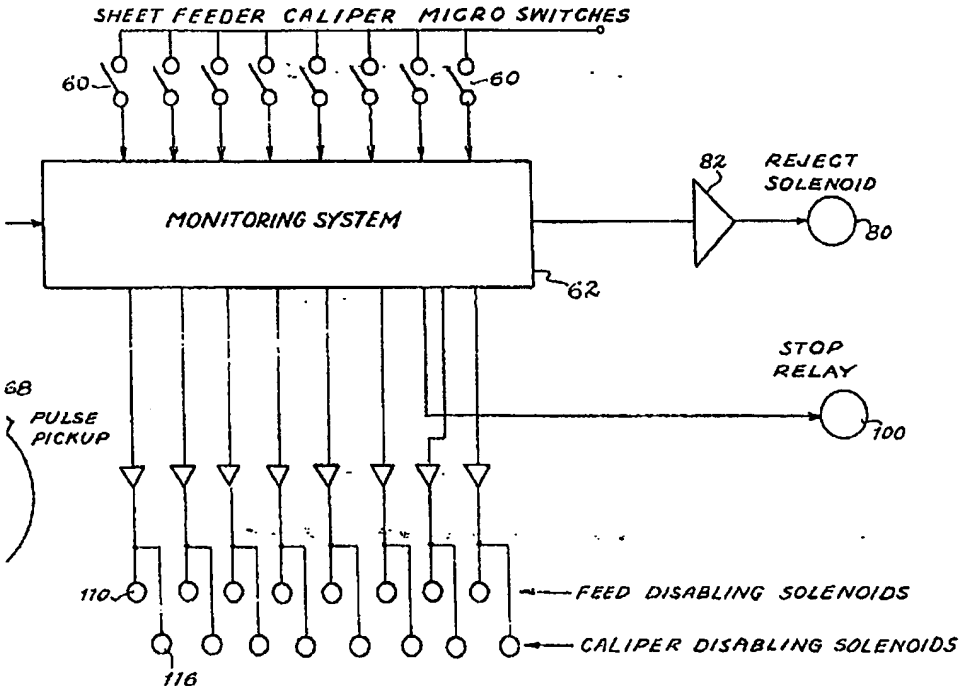


Fig.9.



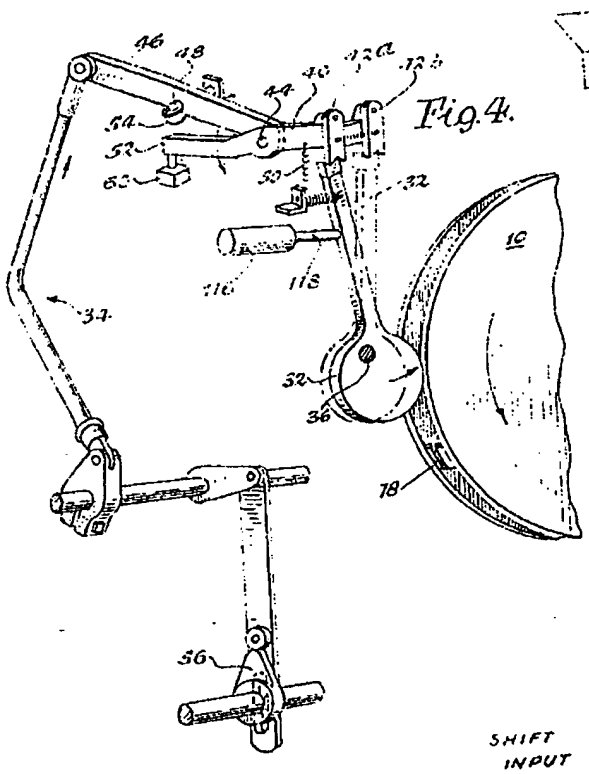
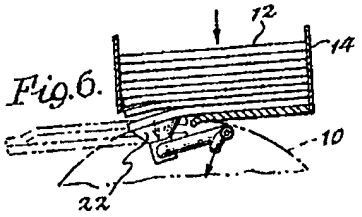


Fig. 4.



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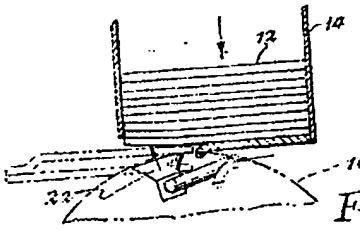

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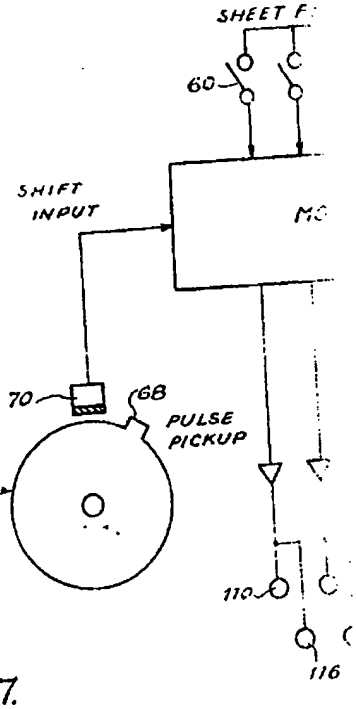

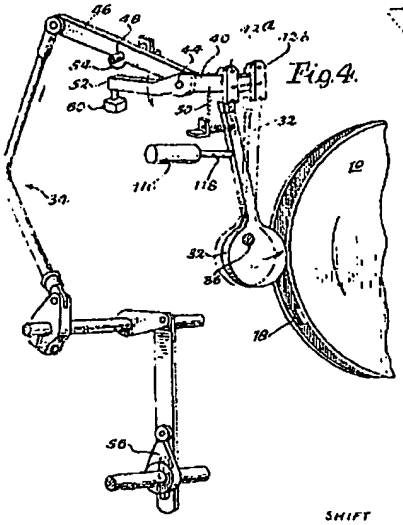

Fig.4.

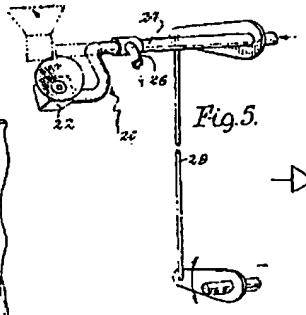

Fig.5.

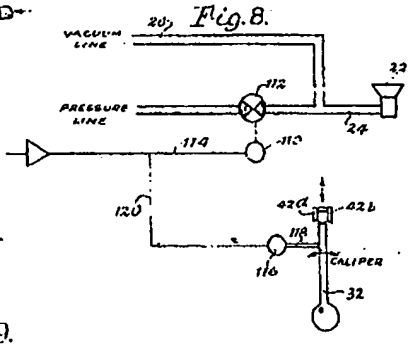

Fig.8.

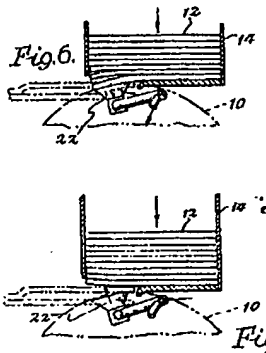

Fig.6.

Fig.7.

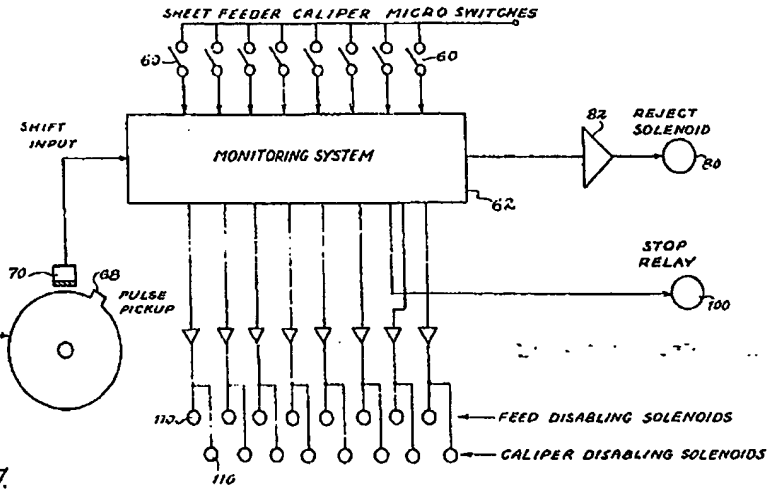

Fig.9.

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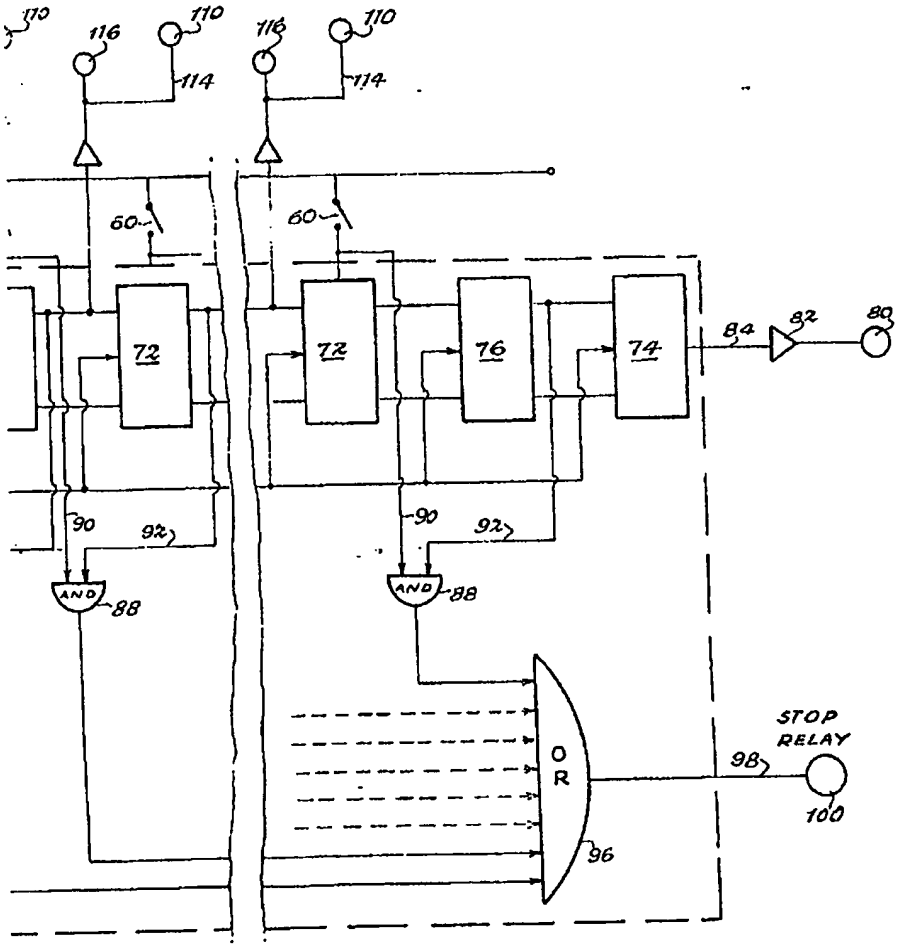
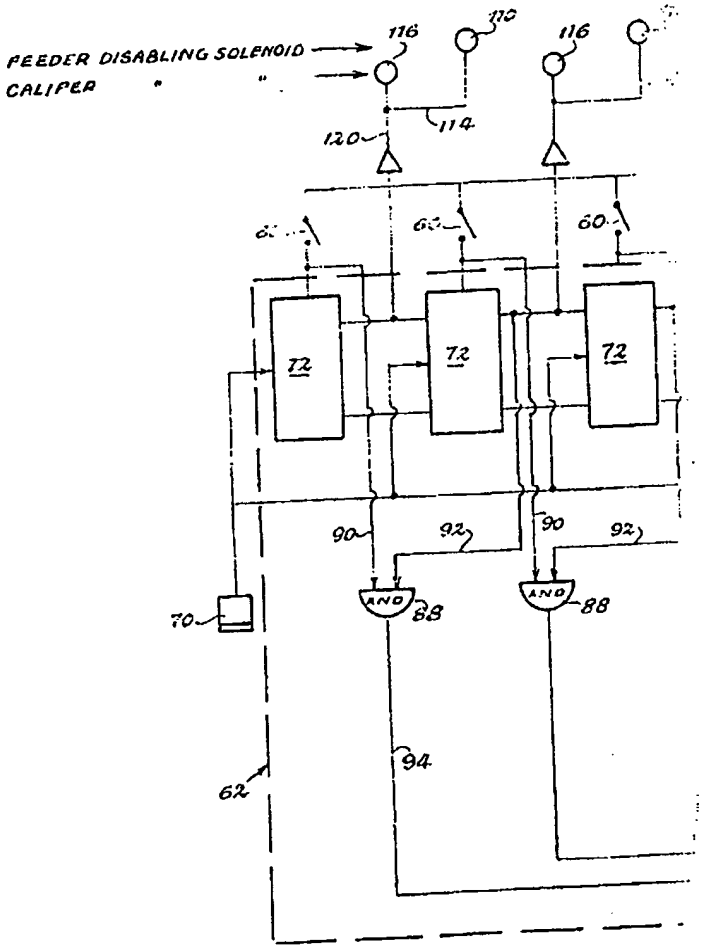


Fig. 10.


FEEDER DISABLING SOLENOID
CALIPER
116
110
116
120
114
60
72
72
72
90
92
90
92
AND
88
AND
88
70
94
62

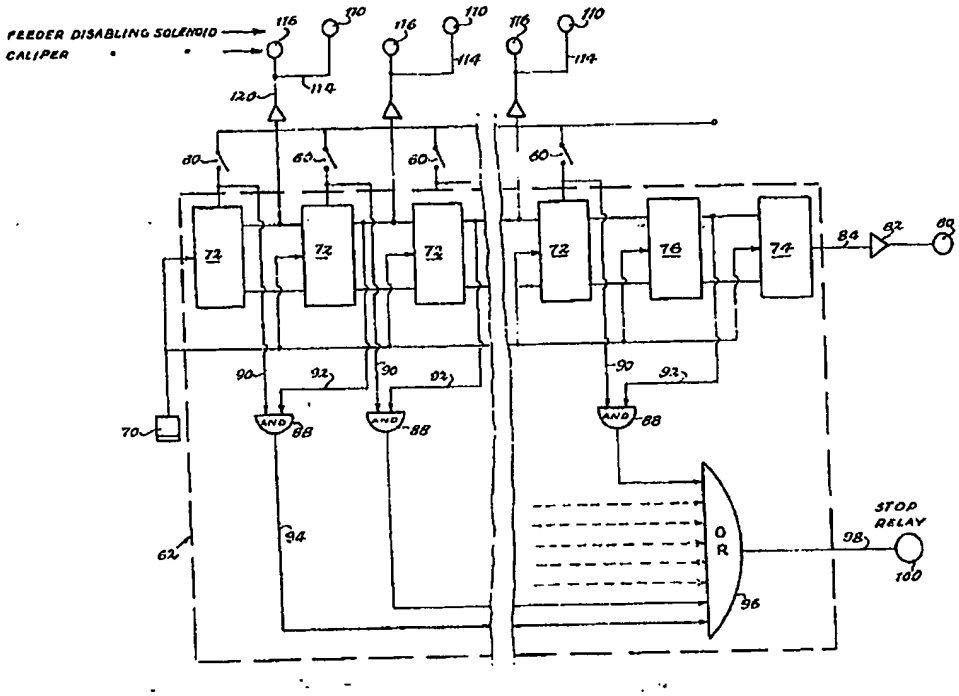

FEEDER DISABLING SOLENOID
CALIPER
116
110
114
120
60
74
72
76
84
82
80
90
92
AND
88
70
62
94
OR
96
STOP RELAY
98
100

Fig.10.